CLEAN VERSION OF SPECIFICATION CHANGES

Page 8, last paragraph:

In some circumstances, it is advantageous to be able to redirect communication traffic associated with one or more selected wavebands from one direction along a path of the system to another direction therealong in order to distribute communication traffic load and also to achieve a shortest communication path from a transmitting node of the system to a receiving node thereof. Thus, it is beneficial that at least one of the paths of the system is operable to support bi-directional radiation propagation therealong, the at least one path including redirecting means for coupling radiation of one or more wavebands from a first direction of radiation propagation to a second direction of radiation propagation along the at least one path, the second direction being mutually oppositely directed to the first direction.

Pages 12-13, bridging paragraph:

The interface 70 includes twelve channel control units (CCU) 250 to 360 and associated optical amplifiers 400 to 550 interconnected as shown in Figure 2; the optical amplifiers 440 to 510 are regenerative optical amplifiers which are selectable between providing purely optically amplified transmission therethrough and regenerative optically amplified transmission therethrough. The interface 70 further comprises fibre couplers 600 to 680 for coupling radiation from one fibre to another; the couplers are fabricated using optical fibre fusion splicing techniques although alternative types of couplers are useable in substitution, for example a form of coupler as described in a United States patent no. US 4 950 045 incorporated herein by reference. On account of its complexity, the interface 70 is a relatively expensive item but provides great flexibility when selectively coupling

optical radiation between the rings 20, 30. Where such flexibility is not required, the interface 70 can be simplified to reduce cost; such simplification will be described later. For example, one possible simplification involves substituting one or more of the regenerative amplifiers 440 to 510 with optical amplifiers identical to the optical amplifiers 400 to 430, 520 to 550.

Page 13, first full paragraph:

Detailed interconnection of the couplers 600 to 680, the CCUs 250 to 360 and the optical amplifiers 400 to 550 will now be described with reference to Figure 2. The couplers 600 to 680 are mutually similar. Moreover, the amplifiers 400 to 550 are also mutually similar, except that the amplifiers 440 to 510 include additional regeneration components. Furthermore, the CCUs 250 to 360 are mutually similar.

Page 13, fourth full paragraph:

Similarly, the fibre 220 of the ring 30 from the westerly (W) direction is connected to an input port of the amplifier 520. The amplifier 520 includes an output port which is connected through an optical fibre to the coupler 650 and therethrough to an input port A of the CCU 350. The CCU 350 comprises an output port B which is connected through an optical fibre to the coupler 660 and therethrough to an input port of the amplifier 530. The fibre 220 in an easterly (E) direction is connected to an output port of the amplifier 530.

Page 14, first full paragraph:

The couplers 600 to 640 are connected to the couplers 650 to 680 through a series of connection chains, each chain comprising an optical amplifier and an associated CCU connected in series.

Page 14, second full paragraph:

Connections from the ring 20 to the ring 30 will now be described. The coupler 600 includes first and second output ports. The first port of the coupler 600 is connected via an optical fibre through the amplifier 450 and then through the CCU 280 to a first input port of the coupler 660. Additionally, the second port of the coupler 600 is connected via an optical fibre through the amplifier 470 and through the CCU 300 to a first input port of the coupler 670. Moreover, the coupler 640 includes first and second output ports. The first port of the coupler 640 is connected via an optical fibre through the amplifier 490 and through the CCU 320 to a second input port of the coupler 670. Furthermore, the second port of the coupler 640 is connected via an optical fibre through the amplifier 500 and through the CCU 330 to a second input port of the coupler 660.

Page 14, third full paragraph:

Next, connections from the ring 30 to the ring 20 will be described. The coupler 650 includes first and second output ports. The first port of the coupler 650 is connected via an optical fibre through the amplifier 440 and through the CCU 270 to a first input port of the coupler 630. Likewise, the second port of the coupler 650 is connected via an optical fibre through the amplifier 460 and then through the CCU 290 to a first input port of the coupler 610. Moreover, the coupler 680 includes first and second output ports. The first port of the coupler 680 is connected via an optical fibre

through the amplifier 480 and then through the CCU 310 to a second input port of the coupler 630. Furthermore, the second port of the coupler 680 is connected via an optical fibre through the amplifier 510 and then through the CCU 340 to a second input port of the coupler 610.

Page 14, fourth full paragraph:

Each CCU is capable of selectively attenuating radiation propagating therethrough corresponding to one or more of the 32 channels. Moreover, applying selective attenuation at the CCUs 250, 260, 350, 360 has the effect of diverting optical radiation to the couplers 600, 640, 650, 680 respectively preceding the CCUs. Such diversion also enables radiation to be added for the diverted channels at the couplers 610, 630, 660, 670 following the CCUs 250, 260, 350, 360 respectively.

Page 15, first paragraph:

In operation, the interface 70 is capable of providing purely optical paths between the rings 20, 30, such paths not being limited in bandwidth; however, bandwidth limitations arise when electrical regeneration is applied therebetween in one or more of the amplifiers 440 to 510. Moreover, the interface 70 is capable of coupling specific selected channels from the ring 20 and directing them in either direction around the ring 30. Furthermore, in a reciprocal manner, the interface 70 is capable of coupling specific selected channels from the ring 30 and directing them in either direction around the ring 20. In Figure 2 and later diagrams, north (N), south (S), east (E) and west (W) are unrelated to geographical compass directions but are merely used for referring to directions on the diagrams.

Page 16, last paragraph:

The CCU 250 includes an optical input port A for receiving radiation, an optical output port B for outputting radiation, an auxiliary optical output C, an auxiliary optical input D, and an electrical input port E for receiving electrical control signals for controlling operation of the CCU 250; the port E is, for example, used for receiving electrical signals for controlling attenuation settings of the attenuators. The CCU 250 comprises within it a demultiplexer 800, a multiplexer 810 and a matrix 818 of 32 liquid crystal attenuators shown included within a dotted line 820; an attenuator 825 is an example of one attenuator within the matrix 818. The demultiplexer 800 includes 32 optical outputs which are directed to convey radiation to their corresponding liquid crystal attenuators in the matrix 818. Outputs from the attenuators are directed to optical inputs of the multiplexer 810 which recombines radiation transmitted through the attenuators to provide output radiation at the port B. When the attenuators are set to attenuate radiation incident thereupon, the radiation is diverted towards a multiplexer 830 which is operable to combine the diverted radiation and provide a corresponding radiation output at the port C. Likewise, the port D is connected to a demultiplexer 840 which is operable to guide radiation input at the port D to the attenuators for propagating onwards to the multiplexer 810 for subsequent output at the port B. In the interface 70, the ports C and D of the CCUs are not normally used although they can be employed in special circumstances, for example when performing a wavelength shift to switch traffic from one channel to another; such a shift will be described later.

Page 17, first full paragraph:

The attenuators are electronically controllable to provide an attenuation through each attenuator in a range of 0.1 dB to 30 dB. The CCUs, supplied by a vendor based in the USA, incorporated within the interface 70 use free-space optics to obtain a minimum insertion loss of 6 dB. If the CCU were not constructed using such free-space optics, for example using more conventional fusion-spliced fibre optics, optical losses through the demultiplexer 800 and the multiplexer 810 would be around 7.5 dB and 4.5 dB respectively resulting in a total minimum insertion loss of 12 dB. Moreover, commercially available CCUs for use in the interface 70 would be considerably more expensive and bulky were they not to employ such a compact free-space optical architecture.

B11

Pages 17-18, bridging paragraph:

The regenerative amplifiers 440 to 510 will now be described with reference to Figure 4. The amplifiers 440 to 510 are similar, hence only the amplifier 440 will be described in further detail. The regenerative amplifier 440 comprises an optical switch 850, a coupler 852, an optical amplifier 854, a waveband selective demultiplexer 856 including 32 outputs connected through mutually similar regenerating chains to a multiplexer 864. As an example, one of the chains comprises a detector 858, an electrical regeneration unit 860 and a modulated laser source 862. Each chain is connected at its output to a corresponding optical input of the multiplexer 864. The optical amplifier 854 is operable to provide non-regenerative optical amplification only.

B12

Page 20, first full paragraph:

B13

The amplifier 970 and its associated CCU 930 are connected in series and are operable to provide a first chain selectively linking communication traffic from the second loop comprising the fibre 200 to the first loop comprising the fibre 210. Likewise, the amplifier 980 and its associated CCU 940 are operable to provide a second chain selectively linking communication traffic from the first loop to the second loop.

Pages 21-22, bridging paragraph:

B14

Interconnection within the interface 1200 will now be described. The fibre 200 of the second loop of the ring 20 from a westerly (W) direction is connected to an optical input of the amplifier 1230. An optical output from amplifier 1230 is connected to the coupler 1270 and therethrough to an optical input port A of the CCU 1210. An optical output port B of the CCU 1210 is connected via an optical fibre to the coupler 1280 and therethrough to an optical input of the amplifier 1240. The fibre 200 in an easterly (E) direction of the second loop is connected to an optical output of the amplifier 1240.

Page 22, first full paragraph:

B15 cont

Likewise, the fibre 230 of the first loop of the ring 30 from an easterly (E) direction is connected to an optical input of the amplifier 1260. An optical output from amplifier 1260 is connected to the coupler 1300 and therethrough to an optical input port A of the CCU 1220. An optical output port B of the CCU 1220 is connected via an optical fibre to the coupler 1290 and therethrough to an

B15 cont'd

optical input of the amplifier 1250. The fibre 230 in a westerly (W) direction of the first loop of the ring 30 is connected to an optical output of the amplifier 1250.

Pages 22-23, bridging paragraph:

B16

The CCU 1210 is operable to attenuate one or more selected channels included in radiation propagating around the second loop of the ring 20. Such attenuation diverts the attenuated radiation to the coupler 1270 and onwards to the first input of the filter and detector 1310. When the filter and detector 1310 is tuned to the wavelength of a channel attenuated at the CCU 1210, radiation propagates through to the detector and gives rise to an electrical signal at the output P1. The signal from the output P1 is directed to the input P2 and is operable to modulate radiation generated by the source 1320 which selectively outputs the modulated radiation at the first or second output depending upon instructions received from the management control unit (not shown). When the radiation is output at the second output of the laser source 1320, it propagates to the coupler 1280 and is coupled into the second loop to propagate further in an easterly (E) direction through the fibre 200 around the second loop of the ring 20. Conversely, when the radiation is output at the first output of the laser source 1320, it propagates to the coupler 1290 and passes therethrough to the amplifier 1250 and onwards in a westerly (W) direction along the fibre 230 of the first loop of the ring 30.

Page 24, first full paragraph:

B17 cont'd

Operation of the interface 1400 will now be described with reference to Figure 7. Information bearing radiation partitioned into 32 wavebands propagates along the fibre 200 from a westerly

direction to the amplifier 1230 which amplifies the radiation to provide corresponding amplified radiation which further propagates from the amplifier 1230 through the coupler 1270 to the CCU 1210. The CCU 1210 receives routing instructions from the management control unit (not shown) to divert radiation of one or more selected wavebands back through to the coupler 1270 and therefrom to the transponder 1410, namely to the W input port of the tunable filter 1420. The filter 1420 receives the diverted radiation by selecting its W input port under instruction from the management control unit. The filter 1420 then filters out radiation associated with a specific waveband to be frequency shifted, and subsequently outputs the filtered radiation at its output port Q_1. The filtered radiation is then used in the source 1430 as stimulating radiation for a tunable laser incorporated therein. The laser is tuned to a different wavelength than that of the filtered radiation. The filtered radiation stimulates emission from the laser to provide corresponding stimulated radiation which is selectively output, depending upon instruction from the management control unit, to either the W or E port of the source 1430. When the W port is selected, the stimulated radiation is diverted to the coupler 1290 and continues by propagating in a westerly direction along the fibre 230. Conversely, when the E port is selected, the stimulated radiation is diverted to the coupler 1280 and continues by propagating in an easterly direction along the fibre 200.

Page 25, first full paragraph:

The interface 1400 can also respond to information-bearing radiation propagating along the fibre 230 from an easterly direction where the radiation propagates to the amplifier 1260 which amplifies the radiation to provide corresponding amplified radiation. The amplified radiation propagates through the coupler 1300 to the CCU 1220. The CCU 1220 is instructed by the management control unit to

divert radiation of one or more selected wavebands in the amplified radiation back to the coupler 1300 and therethrough to the E input port of the filter 1420. The filter 1420 is instructed by the management control unit to accept radiation at the E port. Processing of the selected wavebands of the radiation present at the E port occurs in the source 1430 as described above where corresponding shifted radiation can be output to either the fibre 200 in a easterly direction or to the fibre 230 in a westerly direction depending upon instructions sent from the management control unit.